ARPA
Command Forces (CFOR)
Technology Program

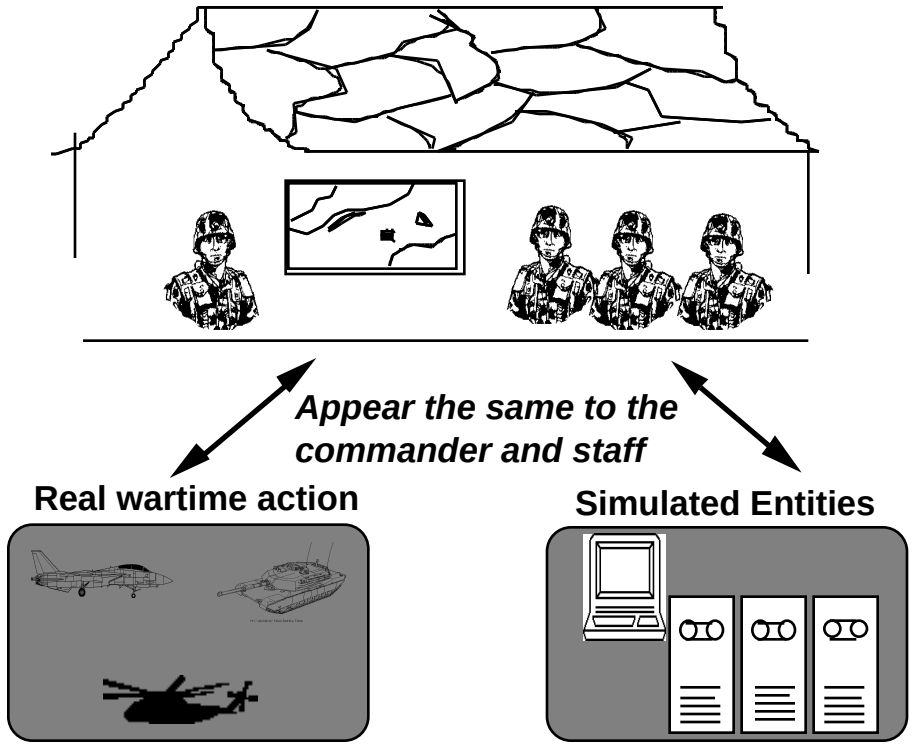
Lashon Booker, Ph.D.

February 28, 1996

STOW Program

- **Synthetic Theater of War (STOW) is an ARPA program to**
  - **Enhance simulation in virtual (DIS) environment**
  - **Widen simulations to include 50,000 entities**
  - **Broaden simulations**
    - = **More types of entities**
    - = **More echelons**
- **ACTD to deliver an exercise support system**
  - **First Use in 1997**
  - **Continuing development and support until 2000**
  - **Initial user is USACOM**

CFOR Charter



- **Bridge the gap between higher echelon commanders and the entity level combat simulation by**
  - **incorporating realistic models of intervening commanders and decision makers**
  - **using a realistic approach to communication, both content and throughput**

CFOR Concept

Command Forces (CFOR) is a part of STOW intended to model Command and Control in a DIS environment

- **Commanders are decision-makers that have a physical presence on the battlefield**

  A separate thinking command entity simulation was designed with links to permit it to see, move, and shoot from its simulated vehicle

- **Commanders communicate via a well-understood language of orders and reports**

  Command and Control Simulation Interface Language (CCSIL) was devised to permit simulated command entities to communicate

- **Communication of orders and reports are subject to battlefield effects**

  CCSIL messages are embedded in DIS Signal PDUs
  ModSAF battlefield effect modeling is used

- **Subordinate forces must obey and report to commanders**

  ModSAF was modified to accept and implement CCSIL orders and generate CCSIL reports

Command Entity Architecture

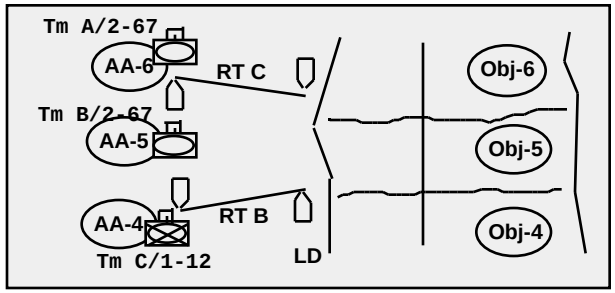
- The automated command entity software models the monitoring and decision-making activity of a commander
- An interface between the CE and environment is provided (an infrastructure to insulate the CE software)
  - Own vehicle interface (sense, move, shoot)
  - Communications (CCSIL message parsing, packing)
  - Reasoning about the environment
  - Schoolhouse knowledge and experience
- The interface between the CE and the infrastructure is well specified
  - Interface Definition Language (IDL), a standard interface specification language from CORBA was chosen

CFOR Development Plan

- **In FY94, MITRE developed and refined CFOR architecture**
- **MITRE develops and maintains CCSIL message sets**
- **CFOR Infrastructure software is designed, developed, and maintained by MITRE**
  - **Initial version of API published in Oct 1994**
  - **Initial version of software in Jan 1995 with quarterly software releases**
- **Contractors design and build command entity software**
  - **Army program initiated in Jan 95 with two contractors chosen by BAA process to develop an Army Company Team commander capable of Attack missions**
    - **SAIC-Burlington (Armor/Mech Co cdr)**
    - **HRL (Armor/Mech Co cdr)**
  - **Co/Team command entities participated in STOW's ED-1 (capable of planning and executing Attack missions only)**

Command Entities in ED-1 (vignette #2)

Battalion Situation: TF 2-67 is operating as part of the 2nd Bde, which is attacking in zone to defeat the 112 MRB's security zone to set the stage for a division level penetration. TF 2-67 is facing 1 MRC that has established hasty defensive positions along a line running from NJ590020 to NJ650080.
Tm B Mission: Attack to seize objective-6
Tm C Mission: Attack to seize objective-4



- TF commander transmits Bn OPORD to all 3 Tms
  - *Human-in-the-loop transmits prepared message*
- Tm C/1-12 receives and acknowledges Bn OPORD
  - *CE receives and parses incoming CCSIL msg*
- Tm C/1-12 Cdr (software CE) initiates mission analysis process, evaluating the METT-T factors
  - *CE display provides some feedback on what the software is doing*
- Tm C/1-12 Cdr generates Co OPORD containing directions for subordinate platoons
  - *CE generates well-formed CCSIL msg*
- Tm C/1-12 Cdr transmits Co OPORD to Bn commander for approval
  - *CE sends CCSIL message over the net*
- TF commander reviews and approves Co OPORD
- Tm C/1-12 Cdr receives approved Co OPORD and transmits to subordinates
  - *CE sends CCSIL message over the net*
  - *Control measures and routes selected by CE appear on screen as part of Operation Overlay*
- Tm C/1-12 begins executing mission
  - *ModSAF adaptation converts CCSIL-encoded mission to task frames*

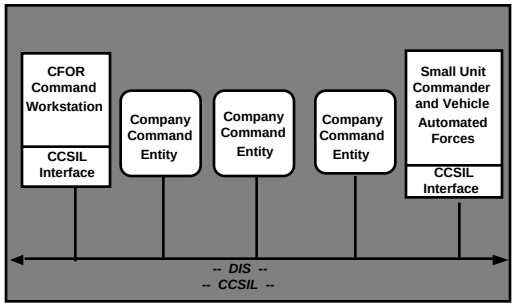
Current Status of Development Plan

- Continue other Army command entity work started in late FY95
  - ARL-UT (FO, FIST, Bn FSE mission execution threads)
  - ISI (Atk Helo Co cdr)
- FY96 Army program focuses on
  - Extending mission coverage for Armor/Mech Co Cdr to Defend, Movement-to-Contact, and Delay
  - Adding combined arms capability to Armor/Mech Co Cdr (e.g., ability to plan for and utilize fire support, logistics, and combat engineers)
  - Adding maneuver CSS infrastructure to simulation (e.g., Co trains, Bn combat trains)
  - Developing more command entities (FIST, Co trains, Bn S2/S3)

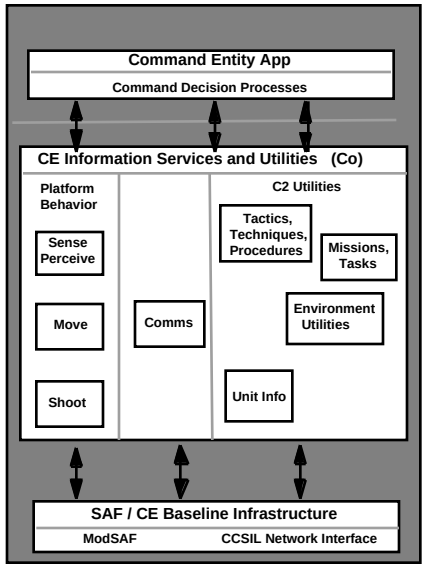
Current Status of Development Plan (continued)

- **USMC program initiated in Jan 96 to develop Rifle Platoon commander**
- **Air Force program intends to build air control element on AWACS platform**
- **Navy program focusing on C2I information passing among simulated entities using CCSIL**

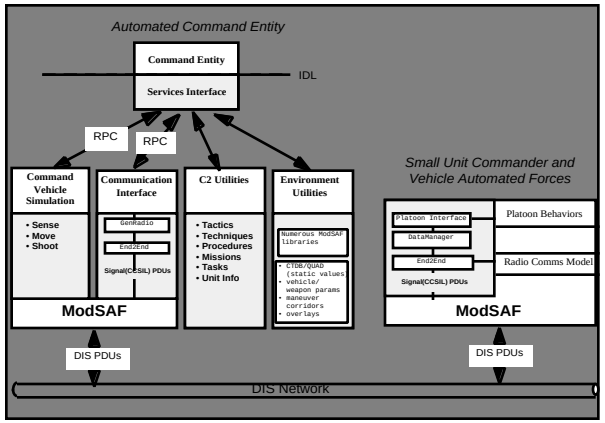
CFOR Progress



General Technical Approach



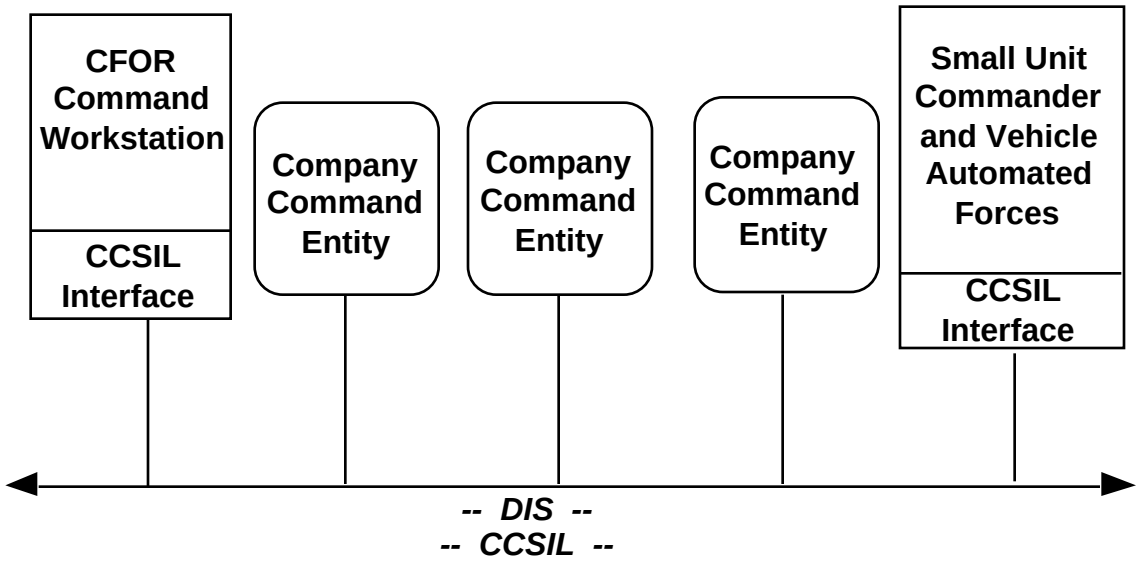
Technical Reference Model



Initial Implementation

General Technical Approach

Extend the SIMNET/DIS paradigm to incorporate the C3 process



Ground Forces Example

- Close match between the real world environment of C3 and the SIMNET/DIS paradigm
  - Command entities
  - Command and Control Simulation Interface Language (CCSIL, pronounced "cecil")
  - Command and control decision-making behavior within command entities
  - C3 information flow among entities

CCSIL

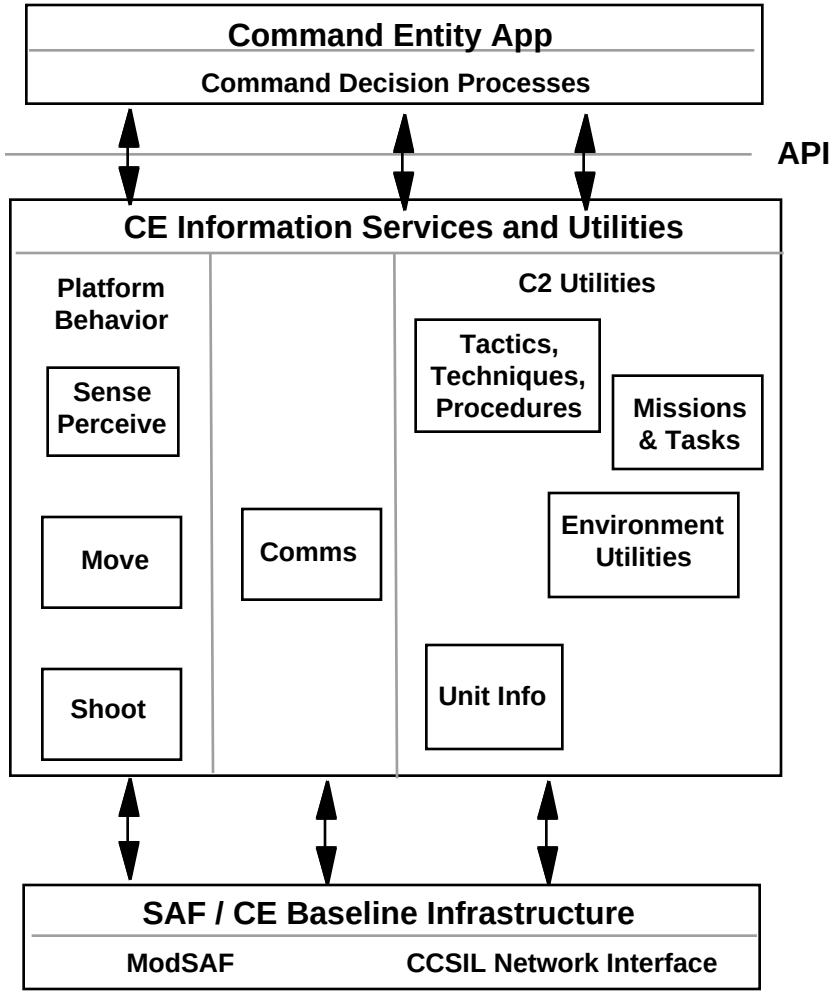
Unit Name	Current Activity	Control Measure Name	Location

Situation Descriptor	Enemy Data

Unit Name (alphanumeric) is the name of the unit.
Current Activity (enumerated) is what the unit is doing at the present time expressed in terms of Task Name.
Control Measure Name (alphanumeric) is the name of the control measure, if applicable. This field is OPTIONAL.
Location (point-location) is the location of the unit.
Situation Descriptor (composite) is a variable length list of other variables that can be used to describe the unit's situation. This field is OPTIONAL. *This is a repeatable field.*
Enemy Data (composite) is a description of the observed enemy units in the area. The information in this part of the report matches the information in a spot report (aka SALUTE report).

- **A language for information exchange**
  - **Among Command Entities**
  - **Between Command Entities and lower echelon units**
- **A set of documents defining the message structure, enumerations, and semantics**
  - **Based on experience (Eagle BML)**
  - **Will evolve with experience during command entity development**
- **Status**
  - **Ground maneuver message set (release 1.3) in use by developers of Army Command Entities and USMC Synthetic Forces**
  - **Navy surface warfare and air warfare message set (release 1.3) in use by Navy Synthetic Forces developers**

Command Entity Technical Reference Model

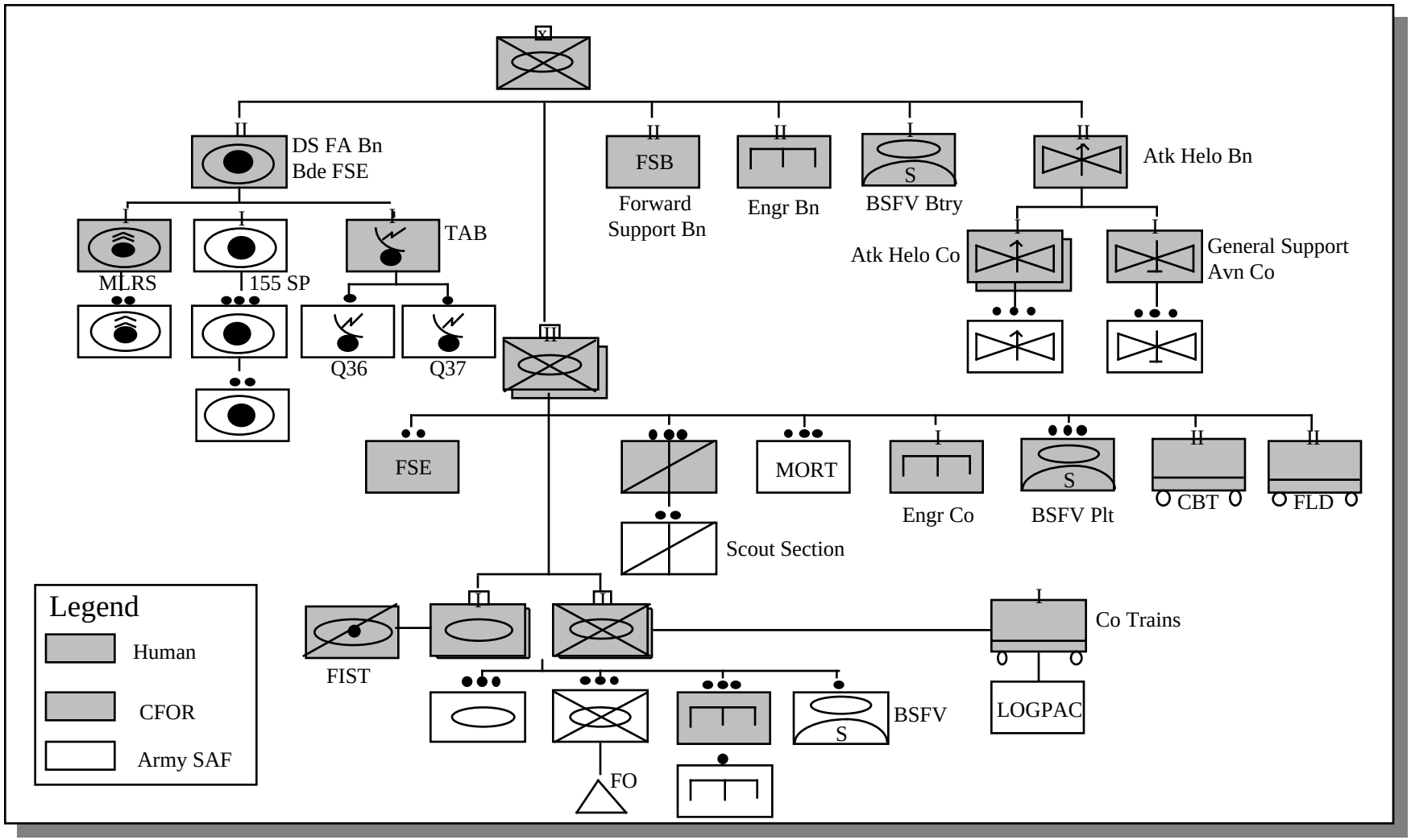


- Command entity (CE) applications are free to implement their own approach to making command decisions
- The CE infrastructure
  - Provides a shared baseline of background knowledge
  - Reduces unneeded redundancy across command entity development efforts
  - Allows command entity applications to focus on command decision behavior

Mission Space for Army CFOR

- **Entities**
  - **Armor and Mech Infantry Bn Task Force (most C2 elements)**
  - **Attack Helicopter Co**
  - **General Support Aviation Co**
- **Actions**
  - **Task Force Missions: Attack to seize/secure objective**
  - **Co Missions: Attack, Defend, Attack By Fire, Support By Fire, Guard, Screen, Reserve, Movement to Contact, Delay**
  - **Aviation Missions: Attack, Reconnaisance, Security Ops**
  - **All related ARTEP tasks for maneuver and supporting combined arms units**
- **Interactions**
  - **Communication of orders, directives, and reports**
  - **Limited support for more complex information exchanges**

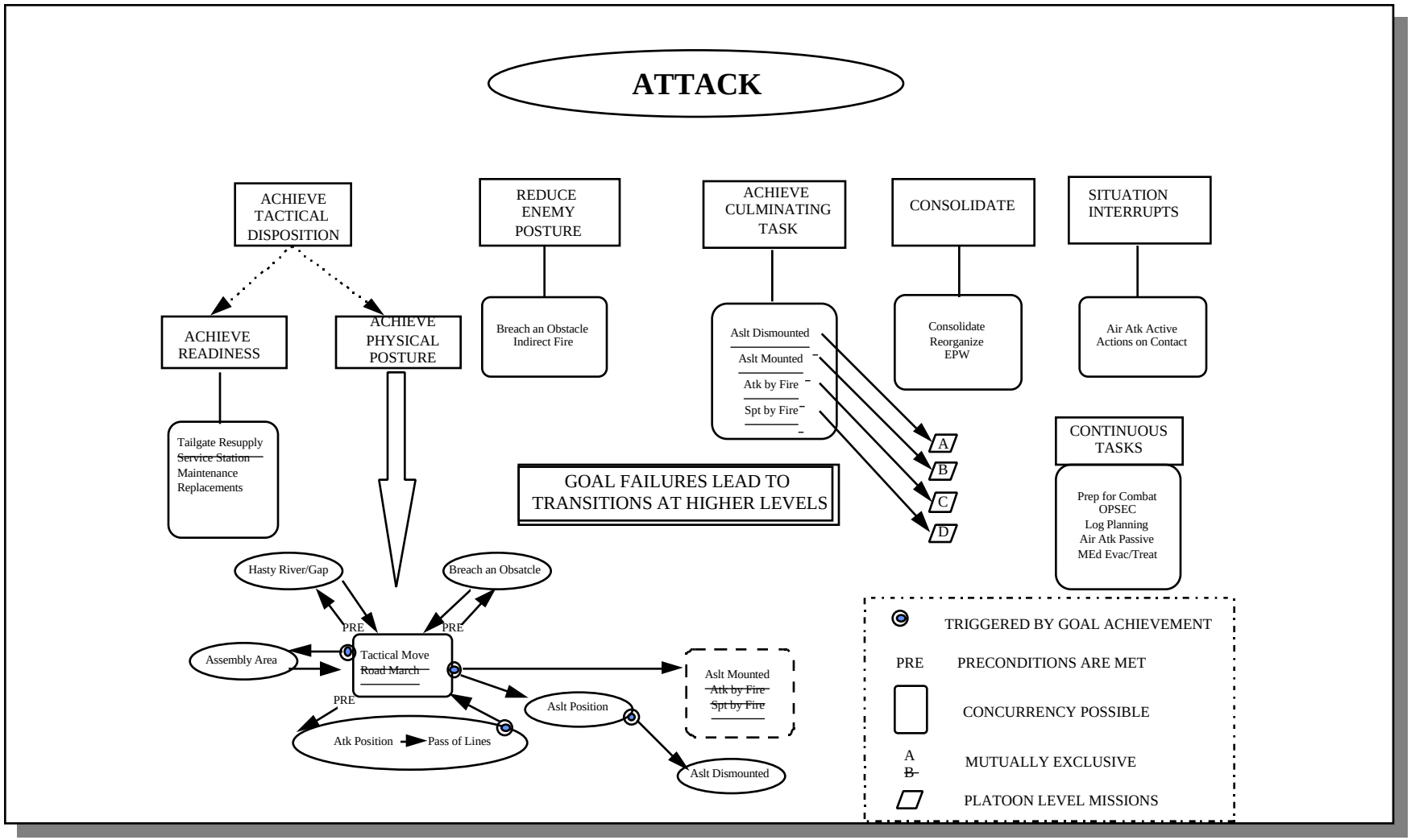
CFOR Army Employment Plan for STOW-97



Army CFOR Knowledge Acquisition

- Structure knowledge in accordance with the Army Training Evaluation Program (ARTEP) approach to describing collective unit behavior
  - Documents provide authoritative descriptions of Army doctrine and tactics
  - Missions are decomposed into a set of standardized collective tasks
  - Each task is specified in terms of doctrinally correct conditions and standards for executing tactics, techniques, and procedures
- Build on the combat instruction set (CIS) descriptions developed by the Close Combat Tactical Trainer (CCTT) program
- Develop supplementary materials describing C2 behaviors (prepared by Logicon/RDA, with knowledge engineering support from MITRE)
- Use virtual Situation Training Exercises (vSTX) and Field Training Exercises (vFTX) to provide context for the specifications and for testing

Mission-to-Task Decomposition



Sample of CCSIL Message Types for Army

√	Operation-Order		Engineer Request
√	Fragmentary-Order		Respond-to-Engineer-Request
√	Execute-Directive		Engineer-Work-Report
	Change-Priority-of-Fire	√	Submit-Air-Defense-Warning
√	Request-Passage-Coordination		Submit-Aircraft-Warning
√	Establish-Passage-Coordination		Change-ADA-Weapons-Control-Status
√	Discourse-Manager		Send-Air-Corridor
√	Unit-Situation-Report		Resupply-Request
√	Unit-Status-Report		Respond-to-Resuppy-Request
√	Report Request		Transportation-Request
	Out-of-Action-Report		Respond-to-Transportation-Request
	Battle-Damage-Report		Medical-Evacuation-Request
√	Fire-Request		Respond-to-Medical-Evacuation-Request
	Fire Mission Information and Control		Replacements-Request
	GSR-Report		Respond-to-Replacements-Request
	Countermortar-Counterbattery-Report		Recovery-Request
	Change-Controlled-Supply-Rate		Respond-to-Recovery-Request
	Change-Main-Supply-Route		Supply-Unit-Logistics-Report

√ Implemented and Used

More Complex Information Exchanges

- **Keywords are used to summarize the purpose of an operation**
- **Briefback status field in Operation-Order is used to model the briefback process between Co and Bn commanders**
  - **“Submit-for-Approval” status in Co order initiates the process**
  - **“Approved” status on returned Co order terminates the process**
  - **“Rejected” status on returned Co order signals new Bn order**
  - **“Clarification” status on Bn order triggers replanning**
- **Request-Passage-Coordination, Exchange-Passage-Coordination message pair to coordinate passage of lines**
- **Simple protocol to model coordinated planning (e.g. Co commander and FIST)**
  - **Co commander sends list of tasks from his COA and associated target priorities as “guidance”**
  - **FIST develops specific target list and fire support plan to insert in Co Operation-Order**

Point of Contact Information

- **Visit the CFOR homepage**
  - **http://alsp.arpa.mil/cfor/cfor.html**
- **Visit the ARPA homepage; find STOW under the ITO home page (currently under construction)**
  - **http://www.arpa.mil**
- **Contact ARPA Program Manager CDR Peggy Feldmann**
  - **pfeldmann@arpa.mil**
- **Contact MITRE CFOR technical team**
  - **Marnie Salisbury marnie@mitre.org**